

Greenwich mean time.	h.	Right Ascension.	North Polar distance.	Distance from Sun's centre in R.A.	in N.P.D.
January 27,	22 ...	309 49 ...	109 33 ...	- 0 32 ...	+ 1 15
28,	0 ...	310 1 ...	109 49 ...	- 0 25 ...	+ 1 32
28,	2 ...	310 13 ...	110 4 ...	- 0 17 ...	+ 1 48
28,	4 ...	310 26 ...	110 18 ...	- 0 10 ...	+ 2 4

The following expressions for the comet's heliocentric co-ordinates to be combined with the X, Y, Z of the *Nautical Almanac*, apply to the same orbit, and may be useful to some of our readers in the other hemisphere who have occasion to learn the right ascension and declination of the nucleus in examining their observations of the track of the tail before the head was visible :—

$$x = r [9.99922] \sin (v + 839.7')$$

$$y = r [9.99079] \sin (v + 279.22.6')$$

$$z = r [9.32714] \sin (v + 82.39.9')$$

$r$  is the radius-vector and  $v$  the true anomaly.

A NEW COMET.—A telegram to the Astronomer-Royal notifies the discovery of a comet at Ann Arbor, Michigan, on April 6, at 11h. Washington time, in right ascension 7h. 20m., and declination  $84^{\circ} 25'$ ; daily motion in right ascension,  $-30m.$ ; in declination,  $-48'$ ; tail,  $3'$ . From a telegram to the Academy of Sciences at Vienna, the name of the discoverer would appear to be Schäberle.

### GEOGRAPHICAL NOTES

THE gold medals of the Royal Geographical Society have just been awarded as follows :—1. To Lieut. A. Louis Palander, of the Swedish Royal Navy, in recognition of the services he has rendered to geographical science as commander of the *Vega* in the Swedish Arctic expedition under Prof. Nordenskjöld, during which he safely navigated the ship along the unsurveyed shores of the Asiatic continent for nearly 3,000 miles, and took the leading part in charting the coasts of Northern Asia. 2. To Mr. Ernest Giles for leading four great expeditions and several minor ones in Australia, and for his route-surveys, geological and botanical collections, and published descriptions of his various journeys. A gold testimonial watch was voted to Bishop Samuel Crowther for his services to geography in the Niger region during the past forty years, and for having aided various expeditions on that river between 1841 and 1857. Prof. Nordenskjöld, having received a gold medal in 1869, was, we believe, in accordance with all precedents, ineligible for another, but, as we have already recorded, he has been elected an honorary corresponding member—an honour accorded to Mr. H. M. Stanley under analogous circumstances. The Council of the Society of Arts at their last meeting elected Prof. Nordenskjöld an honorary life member of the Society in consideration of the services rendered to science by his recent explorations.

MOUNT NAIGUATÁ, in the Venezuelan coast-chain near Carácas, and at a short distance towards the east from the Silla, was ascended by a party from Carácas, August 24 last year. Its height was for the first time carefully determined by Lic. A. Avelledo and Dr. Man. V. Diaz. The barometrical reading on the top was 551.20 mm. (reduced to freezing point), thermometer being at  $13^{\circ} C.$  At the same time observations made in Carácas (Colegio de Santa Maria) gave: Barom. 683.44 mm.; therm.  $24^{\circ} 8'$ , which makes Naiguatá 1,852 metres higher than the lower station, and as this place is 930 metres over sea-level, the total height of Naiguatá is 2,782 metres, or 9,130 Eng. feet. Dr. A. Ernst made botanical and other collections. The rock, wherever it is not covered by vegetation, is amphibolic gneiss, with much quartz, and therefore very hard. A swift (*Chaturax zonalis*, Sclat.) was frequent on the top, but it could not be discovered whether it was nesting there. In the stomach of one specimen a large number of wasps were found. Of beetles there were some *Platynus*, a *Pterostichus*, and a few *Chrysomelidae*, crowded together with some wasps in a narrow cleft between two large stones. Not very far from the top a specimen of what appears to be the moss insect described by Belt ("Naturalist in Nicaragua," p. 382) was caught, clinging to the bark of a stem, which was thickly covered with *Neckera undulata*, Hedw., the likeness between the insect and the branches of the moss being indeed very striking. No butterfly was seen, though there was an abundance of flowering plants; nor were there any land-shells, which was to be expected, on account of the total absence of limestone. Amongst notable

plants growing on the higher part of the mountain the following may be mentioned :—*Arenaria nemorosa*, H.B.K., *Acana*, sp.n. (allied to *A. cylindrostachya*, Cav., and *A. macrorrhiza*, Hook.), *Berberis aurahuacensis*, Ch. Lem. (after Sir J. D. Hooker; the plate in Van Houtte's, "Flore des Serres," iv. tab. 334, however, does not agree; it looks very much like *B. guilache*, Tr. et Pl.), *Liabum hastifolium*, Poepp., *Hieracium avile*, H.B.K., *Gnaphalium incanum*, H.B.K., *Myrsine ciliata*, H.B.K. (the only woody plant which reaches the top), *Sphacele*, sp. n., *Siphocampylus microstoma*, Hook., *Anthriscum coarctatum*, R. et P., *Arthrostylidium longiflorum*, Munro, *Epidenium alpicolum*, Reichb. (several specimens were seen with racemes ten to twelve inches long, and sending forth a sweet vanilla-like smell). It must be remembered that Mount Naiguatá was ascended some years ago by the late Mr. James Mudie Spence, of Manchester, and his party.

WE take the following from the *Times of India*:—It is said that Major Biddulph, stationed on the Kashmir boundary, has prepared a report upon the customs, the languages, and the folklore of the singular communities among whom he has been residing for a long time. "From Major Biddulph's peculiar advantages and opportunities may be expected," says the *Pioneer*, "a complete account of people who are a survival of the old Aryans, from whom all civilised mankind of the present day is probably descended. Surgeon-Major Bellew, meanwhile, has been examining a few men from the cantons on the south-west of Dardistan, peopled by a similar race, who in one respect are still more interesting, for their country has never yet been visited by a civilised traveller. But in appearance and language they closely resemble the Dards, and, unlike them, have not embraced the creed of their Mahomedan neighbours. The tongues spoken in all these hills are, for the most part, Aryan; not descended from Sanskrit, and, indeed, of earlier origin than that classical language. On the northern slopes of the mountains Parsee words prevail in the southern cantons. Some of the words resemble Greek, some Latin, some those of modern Europe. They make, and freely consume, grape wine, something like a crude Burgundy. Those who are not Mussulmans believe in one God, but employ the intercession of minor powers, represented by images. They also occasionally canonise great men whom they have lost by death. They are usually monogamous, opposed to divorce, and strict defenders of the chastity of their unmarried girls. These latter have blue, grey, or hazel eyes; black hair is the exception amongst them, and, when young, they are of such remarkable comeliness as to be in great demand in the slave markets of adjacent countries. Authentic information concerning these interesting races cannot but be anxiously awaited by all who realise the nature of the questions involved."

THE Rev. C. T. Wilson, of the Church Missionary Society's Nyanza Expedition, who has just arrived in England *via* Egypt, from Lake Victoria, will read a paper on "Uganda and its People," at the meeting of the Royal Geographical Society on Monday next. Great interest will attach to this meeting, owing to the expected presence at it of the three Waganda chiefs who have accompanied Mr. Wilson as a deputation from King Mtesa.

FURTHER details are to hand as to the projected Italian Antarctic Expedition, under Lieut. Bove and Commendatore Negri. Committees for subscriptions have been started in the chief Italian towns and the colonies, and it is hoped the expedition will be ready to sail in May, 1881. From the Shetlands the expedition will steer to the south-west, and endeavour to penetrate a line of land which was observed by Dallman, a Hamburg whaler, some few years since. Thence a movement will be made towards the land where Bellinghausen marked the lofty capes of Alexander and Peter, and the western lands observed by Wilkes in 1839. At this point a serious discussion must arise as to future movements. It would be desirable to coast along the land of Bellinghausen if there were any appearance of a "continued mass," steam for the back of the islands which Wilkes believed to exist, and thus enter on the south of Ross's Sea, where the winter might be spent. Should, however, expectation be disappointed, the winter might be passed on the Bellinghausen land, and preparations might be made for entering Ross's Sea. The voyagers think that with a strong vessel it would not be impossible to penetrate beyond Ross's Sea, and complete the studies which were made of the flora, the fauna, and the mineralogy of the Antarctic region. Having examined these lands and seas, it is proposed to move towards Adele, discovered by D'Urville in 1840, and here it is thought it might be

possible to land and winter. Continuing their course to the west, they intend running along by the "Southern Continent," where the existence of land is certain, and endeavour to penetrate through the ice, as did D'Urville, Wilkes, and Ross. The hope is that canals in the ice might be found through which they might attain a remote latitude, or, running along them when massed into a continent, arrive at Kemp or Endermet, where they could pass the second winter.

A JAPANESE paper states that the Swedish skipper Johannesen, who has already done a good deal of exploration in the Spitzbergen seas, is to set out this month from Yokohama in the steamer *Nordenskjöld* to make the North-East Passage in an opposite direction to that taken by the *Vega*, viz., from Behring Straits to Europe.

PROF. NORDENSKJÖLD reached Copenhagen at the end of last week, in the *Vega*, and was received on landing by the acclamations of 20,000 persons. Every one has united to do him and his companions honour, from the Royal Family downwards.

THE death is announced, on the 16th inst., of Mr. Robert Fortune, well known as a botanical collector in China and Japan, and author of several volumes describing his travels in those countries in search of new plants. It was he who introduced the tea-plant from China into the North-West Provinces of India. He was born in 1812.

#### ON THE EMPLOYMENT OF THE PENDULUM FOR DETERMINING THE FIGURE OF THE EARTH

MY object in writing this paper is principally to draw attention to the course which the employment of pendulums has taken, from the time when Richer's first experiment at Cayenne, in 1672, attracted the attention of Newton; and to show in what respect the present aspect of the question is different from that which successive observers, as well as writers upon the subject, have at various times taken. It is no part of my object to discuss the observations themselves, or to discriminate between them, still less to enter upon any investigation of the figure of the earth, except incidentally in alluding to the conclusions which different writers have accepted. But as it is nearly impossible—perhaps not altogether desirable—to hold no independent opinions, I may add that I hope to be able to influence the future course of such operations in a certain direction which will be recognisable as we proceed.

The literature of the subject is very extensive,—not so much in respect of the pendulum itself, or of the use which has been made of it, as on account of the intimate relation which the laws which govern its motion have to larger questions. It is the discussion of these that experiments with the pendulum have influenced, and in general it is only with reference to such influence that the experiments have been instituted, described, and considered; and that in close connection with other operations of wholly different character. It is thus nearly impossible to have a thorough knowledge of the history of pendulum operations without at least a general acquaintance with the history of geodesy, and of that part of astronomical and mathematical literature which deals with the probable forms and constitutions of cosmical bodies. This would be less the case than it is if some of the many writers on the figure of the earth had written less exclusively from their own point of view, and (at any rate in writing of pendulum operations) had dealt more fully with the historical aspect of this particular branch of the general subject: I mean in the modern sense of the word; describing not only the sequence of experiments, but also the development of the comprehension of the questions in issue. I have felt the want of this myself so strongly that now that a somewhat protracted study has partly supplied that want I am fain to attempt this review, in aid of those who may have to prosecute the work.

It is of course impossible to present the course of pendulum operations without continually referring to their intention. At the same time one learns at last that, with one or two exceptions, the intention itself was not well grasped by those who conducted the experiments. Indeed one may almost say that even on the part of those who directed them the intention is not very clear; or more correctly, that it was more confined than we now might wish had been the case. Laplace was not perhaps the first to give utterance to the opinion that the anomalies noticeable in

pendulum results were probably due rather to inequalities of figure than to errors of observation. Nevertheless it is with something of surprise, considering that the importance of his opinion lay latent so long as a practically unrecognised consideration, that we find him saying as follows:—"We shall here remark that the same anomalies. . . arising without doubt from the irregularity of the parts of the earth, are also perceived in the observed lengths of pendulums." That such irregularities existed was doubtless always a suspicion, but the fact was very slow of being recognised, and to this day it does not govern the observations.

In reviewing the course of pendulum operations then we must be prepared to put this aside as a fact which has not entered into account. It may be strange, but such is the case. It follows that a very considerable portion of the discussions and calculations, based on results which I am very far from wishing to impeach, must also be set aside as almost entirely without present value other than as evidence that the breadth of the question had not been measured.

If the absence of a true appreciation of the influence of local irregularity is apparent in the narrowness of the discussion of individual observations, or of small groups of results; it is also noticeable in the rejection of many, on the sole ground that the methods of observation were inferior; without any proof being adduced that the probable error was greater than the probable effect of local irregularity. This may be taken as indicating that there was also on the part of those who set themselves to review the produce of experiment a reluctance to accept as facts the irregularities which now we recognise as necessary concomitants.

Here again it follows that we must be ready to turn aside from conclusions which are seen to rest on the exclusion of an important consideration. But it by no means follows that, in thus finding reason on all hands to go back to the original sources, and to discard more or less summarily much which has been at one time or another accepted as legitimate deduction, there is any occasion to slight those deductions. Mere trials as they have often been, they have served many purposes which we cannot disdain, and (in ways which it is vain now to examine) have placed us in the more advanced position. There is one thing however which they must have no power to effect, and that is to obstruct us in further advance.

At the same time I confess that, for my own part, I cannot turn over the innumerable pages of vain calculations without profound regret that they represent so much labour—not thrown away—but without further use. I would give instances, but perhaps it is better to refrain. If anything could excuse it, it would be the hope of saving some other learner from spending time over them, and that object can perhaps be otherwise secured.

From another point of view I have also been led to perceive a want of distinctness in the plan of operations, which accounts for an otherwise inexplicable diversity in the individual contributions. In studying the history of these operations we are reminded of an edifice which presents different styles; and parts which make up a whole, not so much after any known design as casually. The two principal styles, to continue the metaphor, have indeed a common element which is a key to the whole construction; but though we can perceive that it is there in every part, and was present to the mind of every worker, it scarcely ever amounts to an expressed design by which future work is to be regulated. I allude to the absolute and differential methods. As we cannot properly appreciate the value of the work which has been done without understanding the relation in which these stand to each other, it is necessary to preface the merely historical account by a description of those methods in their relation both to the general purpose and to each other.

The conception of the earth as an oblate spheroid probably preceded the first use of the pendulum as an instrument by which its oblateness could be proved and measured. But the uncertainty which characterised geodetic measures—an uncertainty so great that it was, at a later date, actually the subject of vehement controversy whether the ellipticity was not prolate—was such that Richer's discovery (in 1672) that the length of a pendulum beating seconds at Cayenne was notably less than that of a pendulum beating seconds at Paris, was from its very simplicity and conciseness, a revelation which promised inestimable consequences.

This was not the first time that a measurement of the seconds pendulum figures in the annals of geodesy. Picard had two